

FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)	
)	
)	
The Boeing Company, Application for Authority)	File No. SAT-LOA-20160622-00058
to Launch and Operate a Non-Geostationary Low)	
Earth Orbit Satellite System in the Fixed Satellite)	
Service)	

REPLY OF STRAIGHT PATH COMMUNICATIONS INC.

Straight Path Communications Inc. (“Straight Path”) hereby submits this reply to the Opposition and Response of The Boeing Company (“Boeing”)^{1/} to the petition, comments, and oppositions filed in response to the above-referenced application (“Application”).^{2/} The Opposition and Response do not justify the relief that Boeing seeks. The justification for that relief—a potentially robust market for satellite broadband—is simply belied by the facts and the inherent inefficiency of the technology. Conversely, granting the requested Application would eviscerate the goal of the rules the Commission adopted to make millimeter wave spectrum available for mobile terrestrial operations.

I. SATELLITE BROADBAND IS *NOT* A BROADBAND SOLUTION FOR ALL AMERICANS

In its Opposition and Response, Boeing continues to rely on the unsupportable assertion that satellite broadband is better positioned to serve “all Americans” than terrestrial broadband.^{3/}

^{1/} Opposition and Response of the Boeing Company, IBFS File No. SAT-LOA-20160622-00058 (filed Dec. 12, 2016) (“Boeing Opposition and Response”).

^{2/} The Boeing Company, Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service, IBFS File No. SAT-LOA-20160622-00058 (filed June 22, 2016) (“Application”).

^{3/} See Boeing Opposition and Response at 2-5.

Straight Path has provided facts and data regarding the level of services that satellite broadband and mobile broadband provide to the American public in its previous filings.^{4/} Boeing continues to ignore these facts. But the truth is inescapable.

As demonstrated in Figure 1, below, satellite broadband has not served “all Americans” for the past three decades—not even close. Satellite broadband serves two million subscribers out of 320 million Americans,^{5/} and it accounts for only 4% of overall global telecommunications industry revenues.^{6/} So, even though satellite broadband has been available for decades, most Americans have chosen to use other services that are cheaper, faster, more convenient, and more reliable than satellite broadband.

Conversely, while Boeing and the satellite industry have repeatedly alleged that mobile broadband is underserving the American public, the technology has reached more than 375 million connections in the United States. Boeing and the satellite industry blame terrestrial providers for the broadband gap. They ignore the fact that satellite broadband has existed for just as long, and presumably has been trying hard to serve those unserved and underserved Americans—with limited success.

^{4/} See Reply Comments of Straight Path Communications Inc., GN Docket No. 14-177, *et al.*, at 3-7 (filed Oct. 31, 2016) (“Straight Path Reply Comments”).

^{5/} See SIA Comments at 2.

^{6/} See Satellite Industry Association, “Satellite 101: Satellite Technology and Services,” at 5 (May 2012), available at <http://www.sia.org/wp-content/uploads/2014/11/Website-Refresh14-Satellite-101.pdf>.

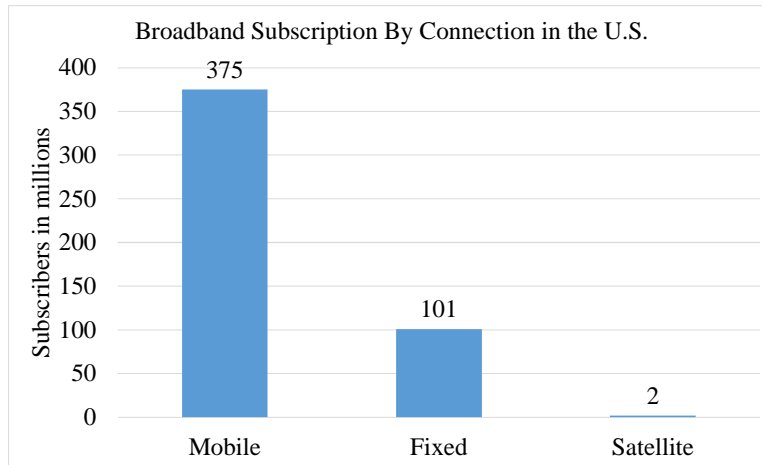


Figure 1. Satellite plays a minor role in providing broadband connections to American public^{7/}

More telling is the fact that satellite broadband is not even a major provider in serving Americans in rural areas. A survey from the NTCA – The Rural Broadband Association found that among the “more than 128 rural telecom and cable companies” that were surveyed by the NTCA “satellite was cited by less than a fraction of 1 percent of respondents”^{8/} as the technology for broadband services.

While Boeing may wish otherwise, satellite broadband is simply a niche market technology that can become competitive against alternatives such as fiber, cable, fixed wireless, and mobile broadband only in rare scenarios. Boeing has exaggerated the public benefits and economic potential of satellite broadband.

^{7/} See OECD Broadband Portal at 1.1.1-1.1.2 (Dec. 2015), *available at* <http://www.oecd.org/sti/broadband/1.1-TotalBBSubs-bars-2015-12.xls> (reporting total fixed and wireless broadband subscriptions by country); Comments of the Satellite Industry Association, GN Docket No. 14-177, et al., at 2 (filed Jan. 28, 2016) (reporting data on satellite broadband connections) (“SIA Comments”).

^{8/} See Jeff Moore, “NTCA: More rural broadband customers are receiving FTTH than other broadband technologies,” *FierceTelecom* (June 23, 2015), *available at* <http://www.fiercetelecom.com/installer/ntca-more-rural-broadband-customers-are-receiving-ftth-than-other-broadband-technologies>.

II. SATELLITE BROADBAND IS EXTREMELY INEFFICIENT AND HAS VERY LIMITED CAPACITY

Boeing's own claims reveal the truth about why the satellite industry is in constant need of more spectrum, even though it only serves a tiny portion of the American public. Boeing claims that "lower FSS [fixed satellite service] spectrum bands [are] approaching saturation."^{9/} That assertion should alarm the Commission, based on the multi-gigahertz of spectrum in the C, X, Ku, and Ka bands designated for FSS, supporting only two million subscribers in the United States. As Straight Path pointed out in its prior submission, geostationary satellite orbit ("GSO") systems are about 100,000 times less efficient in providing broadband access than terrestrial systems.^{10/} This results in very limited capacity despite the vast amount of spectrum used. As a ViaSat spokesperson admits, with 3 gigahertz of spectrum, ViaSat-1 can only "serve around 700k subscribers – and can't add any more because the satellite is full."^{11/} It is this extreme inefficiency that leads to the satellite industry's need for extremely large amounts of additional spectrum, despite its small customer base. Boeing also admits its own proposed system has "tremendous bandwidth requirements"^{12/} and requires "access to an entire five gigahertz of V-band spectrum".^{13/}

The Commission must take a holistic view of millimeter wave spectrum use and balance allocations to best meet the needs of the American public. For less than 1% of mobile

^{9/} See Boeing Opposition and Response at ii.

^{10/} See Straight Path Reply Comments at 5; *see also* Comments of Straight Path Communications Inc., GN Docket No. 14-177, *et al.*, at 27-30 (filed Jan. 26, 2016) ("Straight Path Comments").

^{11/} See Nilesh Christopher, "Companies racing to launch satellites to provide super fast internet," *The Economic Times* (Oct. 24, 2016), *available at* <http://economictimes.indiatimes.com/tech/internet/companies-racing-to-launch-satellites-to-providesuper-fast-internet/articleshow/55020588.cms?from=mdr> (quoting Heather Ferrante, spokesperson of ViaSat).

^{12/} See Boeing Opposition and Response at 21.

^{13/} See *id.* at 5.

subscribers, the satellite industry already has as much, if not more, spectrum than terrestrial services. The Commission has taken a step in the right direction by allocating the 37–40 GHz band for mobile service in the *Spectrum Frontier NPRM*. Boeing’s Application, and more specifically its requests to significantly raise satellite PFD limits and allow unlimited satellite user equipment in the 37–40 GHz band, will negate much of the potential to enable mobile broadband in this band and potentially jeopardize a successful 5G launch altogether. Allocating additional spectrum to satellite broadband—at the expense of 5G terrestrial networks would not serve the public interest.

III. BOEING’S PROPOSAL FOR INCREASED PFD LEVELS IN THE 37–40 GHZ BAND CAN CAUSE CATASTROPHIC INTERFERENCE TO 5G SERVICES

Boeing claims that it “has thoroughly demonstrated that the operation of Boeing’s system at these higher power levels will cause only negligible (*i.e.*, 0.65 dB) degradation to UMFUS systems and only on rare instances of high rain fade when an UMFUS receiver is pointing directly at a satellite above 45 degrees.”^{14/} This is untrue. For example, as Straight Path has demonstrated, if a 5G mobile station receiver with a 4×8 antenna array steers its beam toward a satellite at 50 degree elevation angle, the noise level of this receiver will rise by 2.5 dB.^{15/} This level of degradation is not acceptable. Neither is this instance rare, as the strongest path to a mobile user is often a diffraction path from the top of a building or tree. Boeing’s analysis is limited and relies on restrictive assumptions on the configuration and operation of 5G stations that will seriously dampen the prospect of a successful 5G ecosystem in this band. In addition, Boeing’s entire analysis is based on the assumption that satellite signals will only interfere with 5G stations via the line-of-sight paths from the satellites to 5G stations. This assumption is

^{14/} *Id.* at 14-15.

^{15/} *See* Straight Path Reply Comments at 13, Figure 7.

wrong, as many man-made structures, including roads, pavement, buildings, windows, and roofs, are highly reflective at millimeter wave frequencies. Boeing's results are recklessly optimistic and preliminary at best.

Boeing claims that “authorizing V-band satellite service does not require the Commission to choose between terrestrial and satellite services”.^{16/} This may be the case, except in its application Boeing requests that the Commission increase the FSS PFD limit by 12 dB and allow unlimited satellite broadband user equipment in this band. In the *Spectrum Frontiers Report and Order*, the Commission and the mobile industry made significant accommodations for satellite interests, in both the 28 GHz band and the 37-40 GHz band. As Straight Path has repeatedly shown,^{17/} even the current PFD limit of -117 dBW/m²/MHz will already cause non-negligible impairments to 5G services in the band. Increasing the satellite PFD limit to -105 dBW/m²/MHz will materially harm 5G systems in this band and jeopardize the prospect of 5G deployment in this band.

It is impossible for densely deployed satellite broadband user equipment and densely deployed 5G stations to coexist without suffering from unpredictable levels of interference. Boeing has not demonstrated the ability to provide any guaranteed level of service in the presence of strong interference from 5G. In fact, Boeing's description of the design and operation of its user equipment is theoretical and lacks consideration of impairments and challenges in realistic product development. For example, for a realistic phased antenna array and transceiver design with marketable cost, side lobe and leakage suppression is particularly challenging, especially when the receiver attempts to steer the beams off broadside. Even for highly engineered dish antennas in multi-million-dollar gateway stations, spillover is also a

^{16/} Boeing Opposition and Response at ii.

^{17/} See Straight Path Comments at 14; Straight Path Reply Comments at 19-20.

significant issue, as Nokia pointed out in recent filing.^{18/} There, Nokia noted that “[t]he measured [FSS interference] levels were higher than expected in front of the dish and were typically 20 to 30 dB above the - 77.6 dBm/m²/MHz at the 200 meter distance as requested by the “Joint Filers” to protect 5G systems from FSS earth stations interference,” and “[t]here was relatively equal levels of [PFD] measured at all angles. In general there was only about a 10 dB reduction in the PFD that was detected at 22.5°, 90°, 120° and 180° as compared to that measured at 0°.”^{19/} Straight Path expects that dish antennas for satellite broadband user equipment will have an even bigger spillover issue, necessitating interference protection from 5G services in order for the satellite broadband user equipment to function. A receiver that perfectly suppresses interference from all angles except its desired signal simply does not exist; nor does a perfect environment where satellite signals and terrestrial signals travel in completely separate paths. While the 5G community has been making strides in technology, standards, prototypes, demonstrations, and field trials to bring 5G services in reality, Boeing’s hypothetical system has none of those.

IV. CONCLUSION

Boeing’s Opposition and Response do not justify all of the relief it seeks. As a result, the Commission should deny Boeing’s requests to: (1) increase the FSS PFD limit to -105 dBW/m²/MHz in the 37-40 GHz band; and (2) allow unlimited satellite user equipment on a secondary basis in the 37-40 GHz band. Straight Path does not oppose to the other waivers in Boeing’s application, nor does Straight Path oppose to Boeing’s operation in the 37-40 GHz band in accordance with the rules specified in the *Spectrum Frontiers Report & Order*,

^{18/} See Comments of Nokia, GN Docket No. 14-177, *et al.*, at Appendix 2 (filed Sept. 30, 2016).

^{19/} *Id.* at Appendix 2, 43.

specifically staying within the PFD limit of $-117 \text{ dBW/m}^2/\text{MHz}$ and operating a limited number of satellite gateway stations with proper interference coordination.

Respectfully submitted,

/s/ Davidi Jonas

Davidi Jonas, President and CEO
Jerry Pi, Chief Technology Officer

STRAIGHT PATH COMMUNICATIONS INC.
600 Sylvan Ave. Suite 402
Englewood Cliffs, NJ 07632

December 19, 2016

CERTIFICATE OF SERVICE

I, Gregory B. Simon, hereby certify that on December 19, 2016 a copy of the Reply of Straight Path Communications Inc. was served by first-class mail, postage paid, on each of the following:

Audrey L. Allison
Senior Director, Frequency Management Services
THE BOEING COMPANY
929 Long Bridge Drive
Arlington, VA 22202

Bruce A. Olcott
Preston N. Thomas
JONES DAY
51 Louisiana Ave. NW
Washington, D.C. 20001

/s/ Gregory B. Simon
Gregory B. Simon